Tropospheric O3 and CO from EOS MLS and GEOS-CHEM

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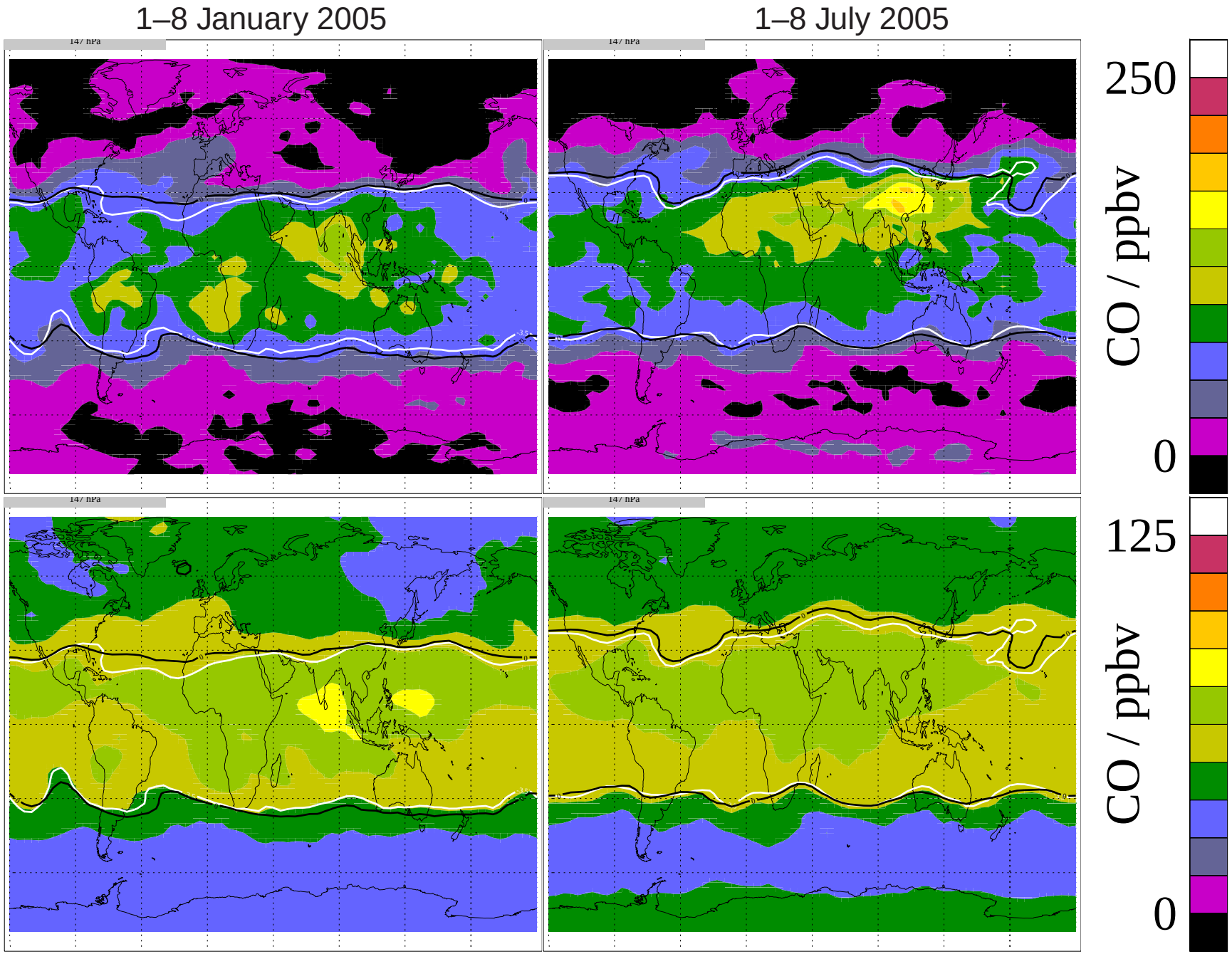
Measurements and model

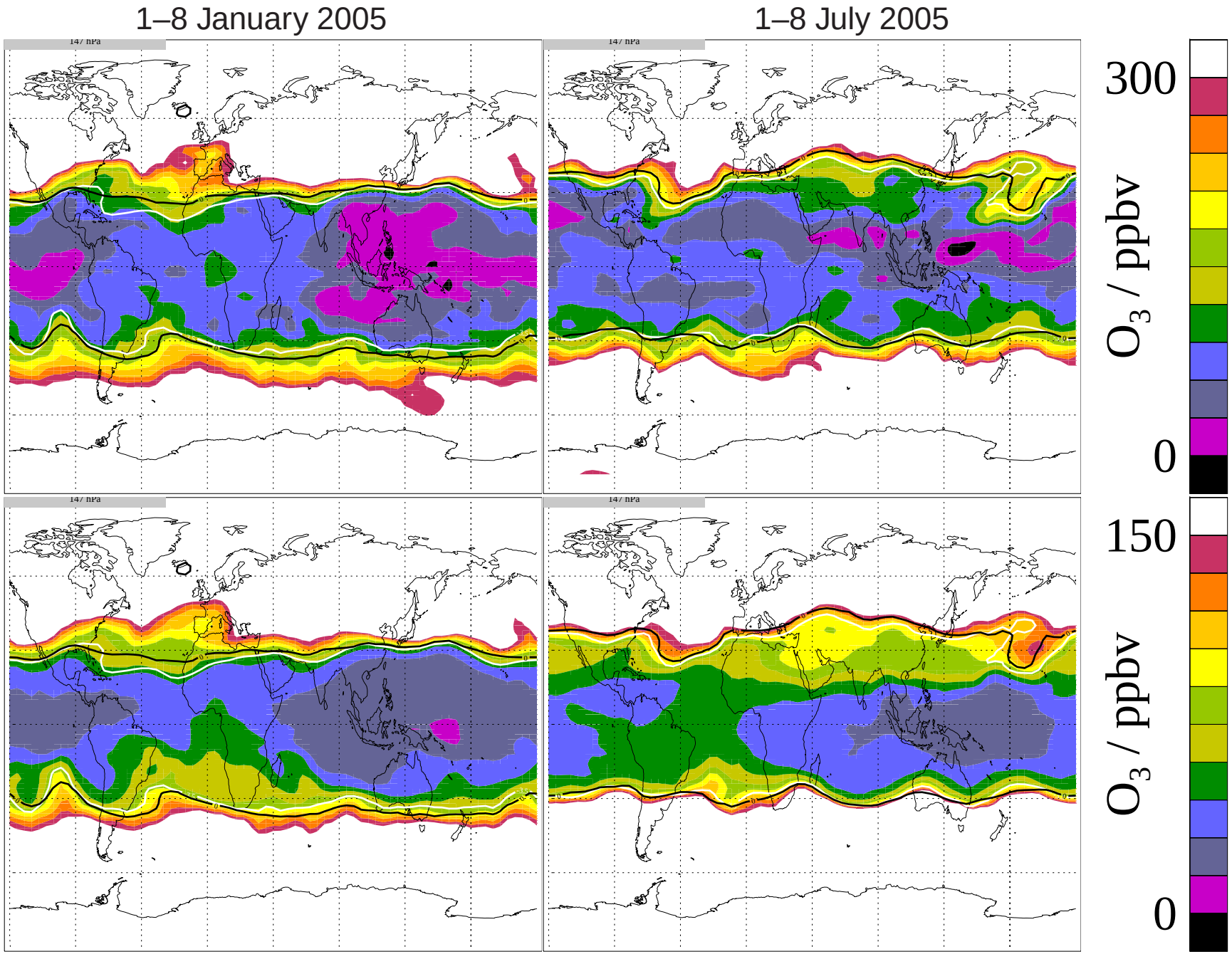
- EOS MLS
  - Current useful measurements to 215 hPa: can observe tropical/sub-tropical upper troposphere.
  - Validation against AVE (Argus, WAS, NOAA O3) and sondes (SHADOZ) indicate that CO has large scaling error at 215 hPa ($\sim 2\times$), and O3 has $\sim 1.25\times$ scaling and large scatter throughout UT.
  - 215 hPa results may be influenced by H2O/cloud.
- GEOS-CHEM (chemical transport model, using GEOS-4 analyses)
  - NRT results: emissions come from climatology.
  - Results presented here only extend to ~ 100 hPa.
- Concentrate on 147 hPa level, best overlap between MLS and GEOS-CHEM.
- Use 8-day means: these evenly cover the tropics with MLS measurement points, but don't smear out (too much) dynamical features in the subtropics.
  - Compare global fields for January 1–8 and July 1–8.
  - Ozone at 100 hPa in the Asian monsoon.
  - Carbon monoxide from the recent fires in South America.

CO at 147 hPa from MLS (top) and GEOS-CHEM (bottom)



- NB different scales for MLS and GEOS-CHEM!

O3 at 147 hPa from MLS (top) and GEOS-CHEM (bottom)



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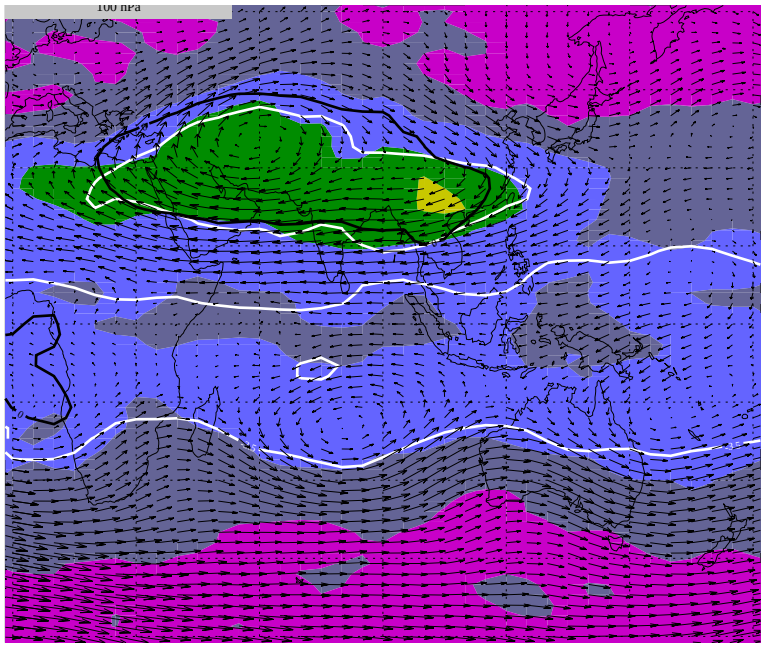
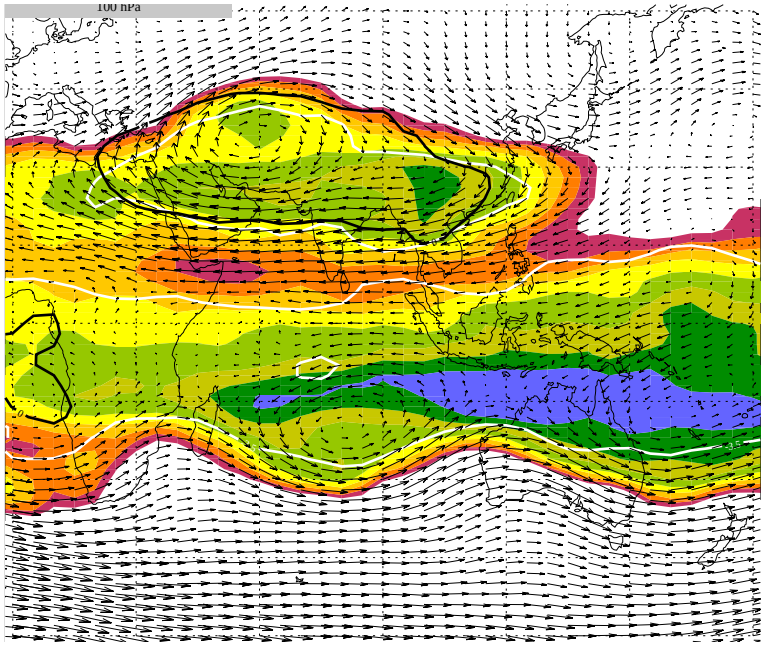
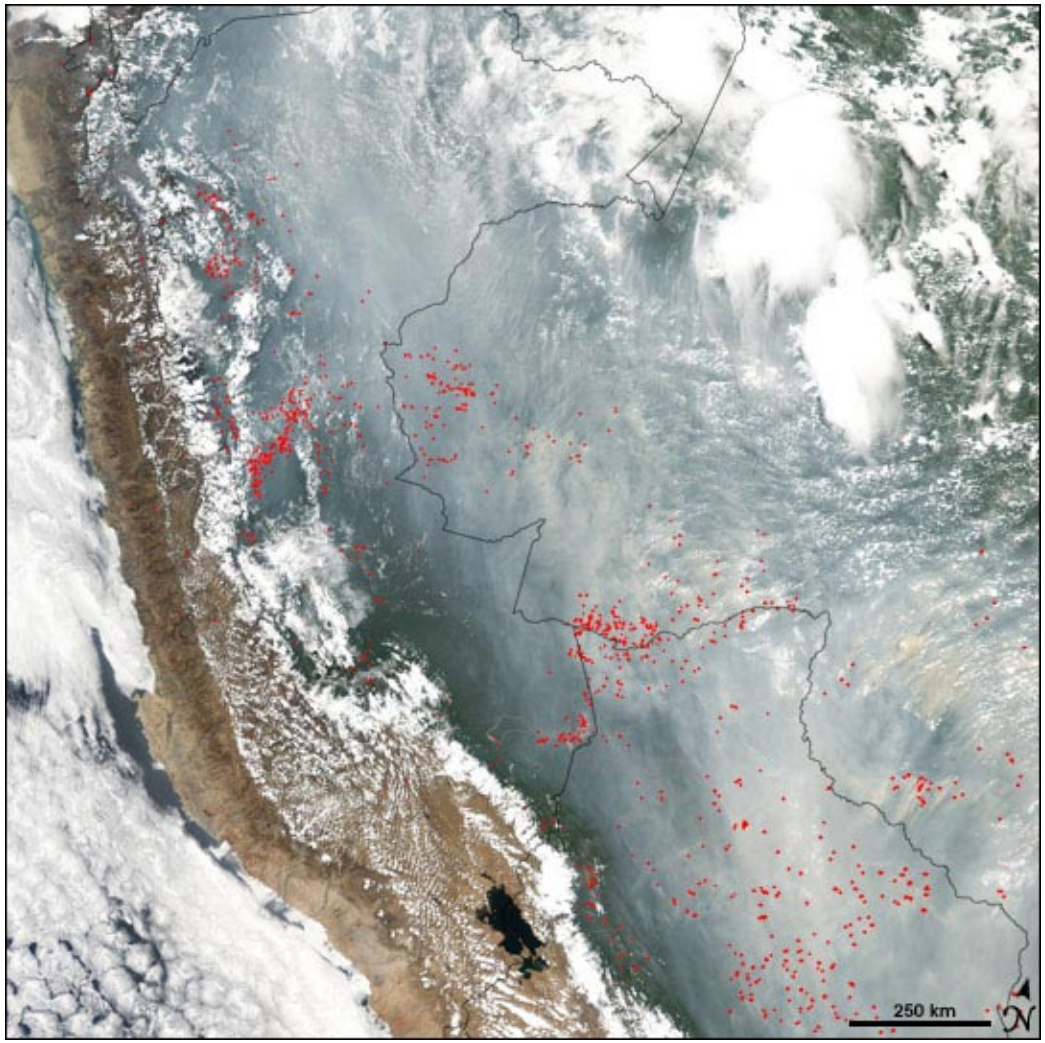
MLS 100 hPa 3–10 July 2005 (Asian Monsoon)





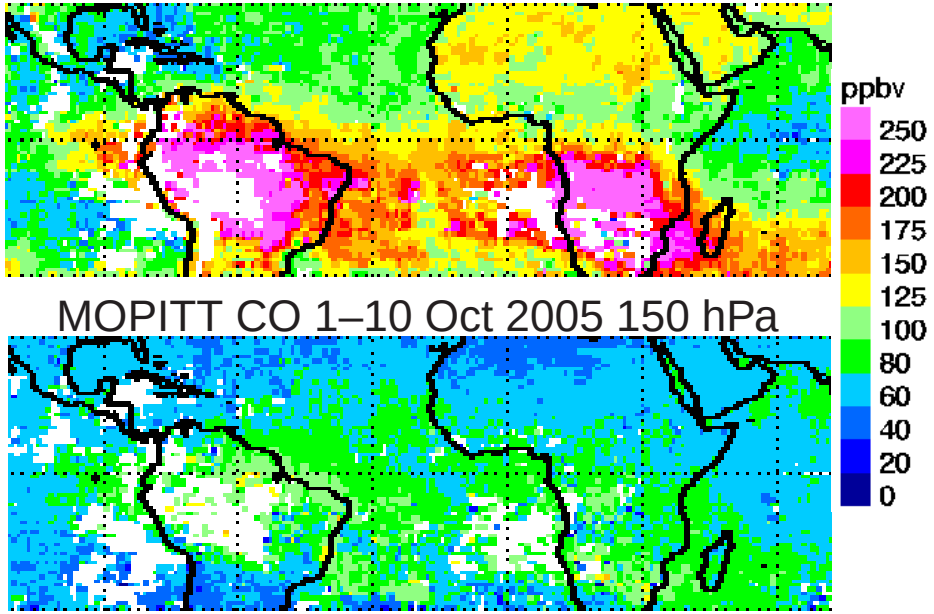
- As in 2004, enhanced CO in UT over India/Tibet/China during the Asian Monsoon. Tropopause is high over same region.
- Stratospheric air is pushed southward, associated with tropical easterly jet.
- No evidence that this structure leads to enhanced strat-trop exchange.

Fires in South America Sep/Oct 2005: MODIS and MOPITT



- Large numbers of fires were burning over South America during September/October 2005, as seen in the MODIS-Aqua image on the left, taken 20 Sep 2005 (image from www.earthobservatory.nasa.gov).

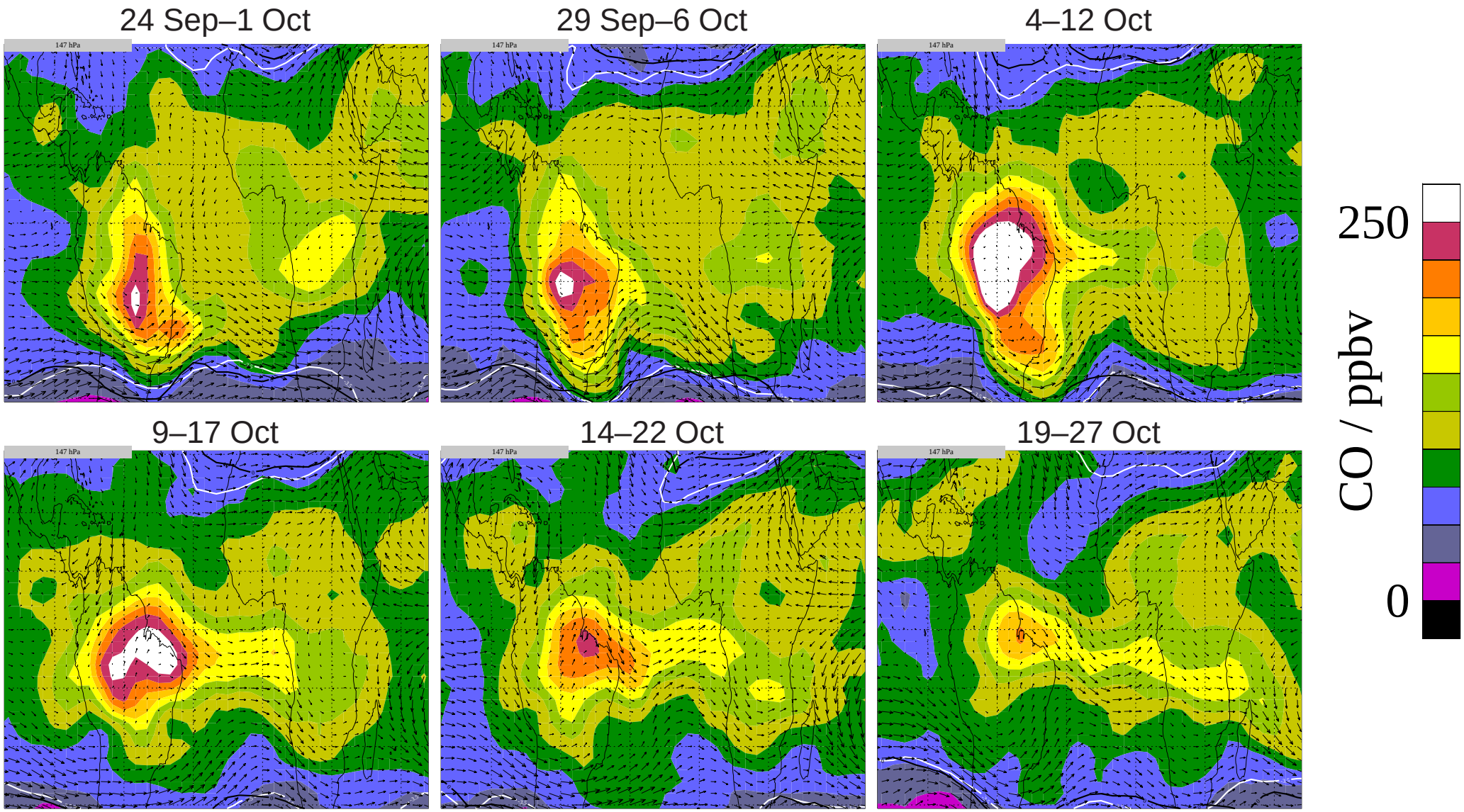
MOPITT CO 1–10 Oct 2005 850 hPa



MOPITT CO 1–10 Oct 2005 150 hPa

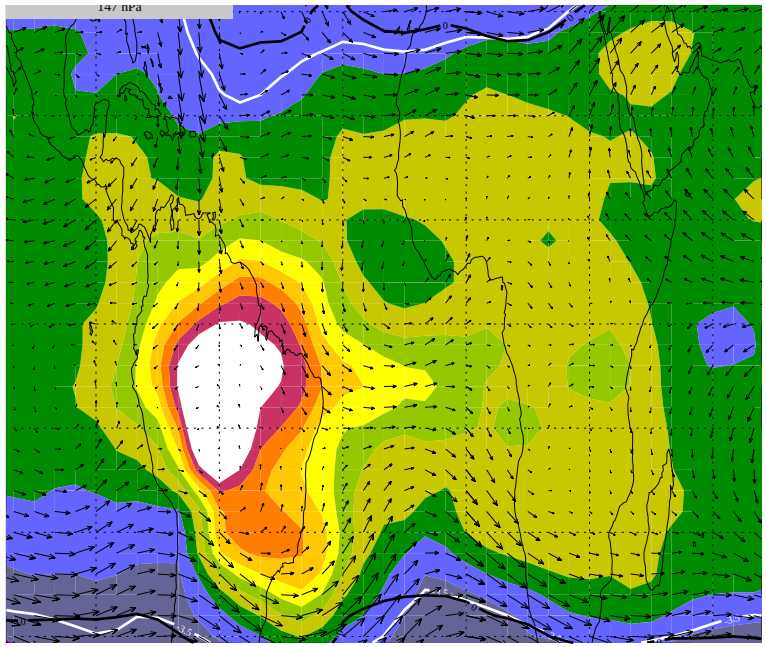
- MOPITT observes enhanced CO at 850 and 150 hPa in October 2005.

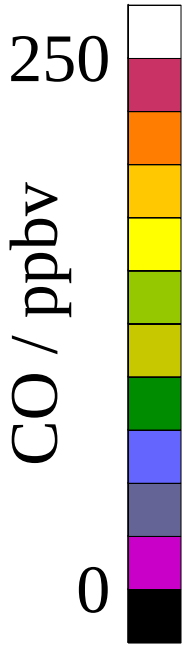
Fires in South America Sep/Oct 2005: EOS MLS CO at 147 hPa

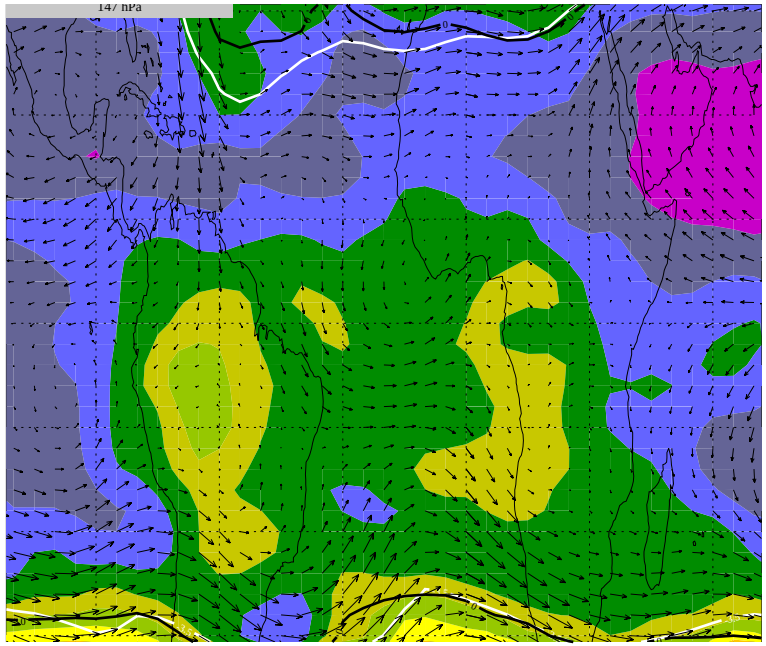


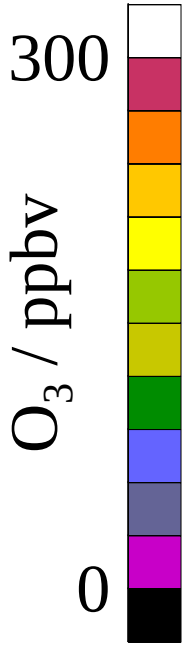
- MLS observes large injection of CO into the upper troposphere.
- Mixing ratios exceed 250 ppbv.
- Plume of CO is transported by high-level winds to southern Africa. Transport also evident at 100 hPa, but not at 215 hPa.

Fires in South America Sep/Oct 2005: EOS MLS O3 at 147 hPa









- Transported O3 precursors (CO, NOx, hydrocarbons) could lead to enhanced O3 in the upper troposphere.
- There does **appear** to be an enhancement in the 4–12 Oct period, shown on the left,
- but O3 not correlated with the CO plume, in time or space, and
- enhanced O3 seen in other regions also.
- Needs further work to confirm any O3 enhancement.

Further work

- Results for GEOS-CHEM runs using estimates of current emissions will become available and may improve the agreement with MLS.
- Investigate possible STE during the Asian monsoon—probably limited by MLS's vertical resolution.
- Look at CO–O3 correlation over South America.